



Національний технічний університет України  
«Київський політехнічний інститут імені Ігоря Сікорського»  
Фізико-технічний інститут

**КРИПТОГРАФІЯ**  
**КОМП'ЮТЕРНИЙ ПРАКТИКУМ №1**  
**Експериментальна оцінка ентропії на символ джерела**  
**відкритого тексту.**

Виконав:  
студент III курсу ФТІ  
групи ФБ-95  
Чорний Анатолій  
Перевірила:  
Селюх П.В.

## Мета роботи:

Засвоєння понять ентропії на символ джерела та його надлишковості, вивчення та порівняння різних моделей джерела відкритого тексту для наближеного визначення ентропії, набуття практичних навичок щодо оцінки ентропії на символ джерела.

## Результати:

### Ентропія:

H1 text with spaces: Redundancy H1 text with spaces	4.373595356265287 0.12528092874694252
H2 text with spaces: Redundancy H2 text with spaces	3.977205421124395 0.20455891577512098
H2 text with spaces: Redundancy H2 text with spaces	3.9760836721728126 0.20478326556543747
H1 text with spaces: Redundancy H1 text with spaces	4.451059345217141 0.1097881309565718
H2 text with spaces: Redundancy H2 text with spaces	4.129907085708902 0.17401858285821947
H2 text with spaces: Redundancy H2 text with spaces	4.128074937575835 0.17438501248483296

## Monograms:

**Зелений колір – 10%**

**Жовтий колір – 25%**

**Червоний колір – 50%**

Spaces	No spaces
0.1598065262327126	о,0.11463600697026566
о,0.09631639212145293	е,0.08670653656215749
е,0.07285024134851462	а,0.07894256442668435
а,0.06632700485080383	н,0.07139742129863098
н,0.0599876269943981	т,0.06740055000199902
т,0.056629482958857544	и,0.06613255747567222
и,0.055564124276184276	с,0.052966750768151626
с,0.04450230316996131	л,0.047664199727248335
л,0.04004713590796717	в,0.04354940390995128
в,0.03658991249350111	р,0.04173960697080921
р,0.035069333434115106	м,0.031550685242002836
м,0.026508670807571844	д,0.031429924049019335
д,0.026407208075888675	к,0.029325113188763186
к,0.02463876032970621	у,0.025509788920509122
у,0.021433150870655785	п,0.02501904460942514
п,0.0210208308435809	я,0.02014726252201671
я,0.016927592721785446	ь,0.0195215736563572
ь,0.016401893199239098	г,0.019442146831441878
г,0.016335159322024666	ы,0.019433636814486666
ы,0.01632800926375169	з,0.017914396168529734
з,0.015051553622542976	б,0.01649119714249593
б,0.013855791496129265	ч,0.016416633184412156
ч,0.013793143366499389	й,0.01034818061753965
й,0.008694470859937508	ж,0.010142319255004008
ж,0.008521507545524592	х,0.00792444674091431
х,0.0066580661680011735	ш,0.007641184747976489
ш,0.006420071371200723	ю,0.006145042719469425
ю,0.005163023031018655	э,0.005777896273687356
э,0.0048545490883845945	щ,0.0035478665925187825
щ,0.002980893341899784	ц,0.003188824924789298
ц,0.0026792289785733184	ф,0.001671205234442885
ф,0.0014041352532261234	ъ,0.000276372931593125
ъ,0.0002322066543889952	

## Bigram with spaces, with intersetcions

о,0.02141613421413002	за,0.005185496408286171	сь,0.0028777291951959764	ек,0.0014323954950531794
е,0.017855744460916066	ол,0.005090502744601874	со,0.0028491289523662955	ще,0.0014225216016953135
н,0.01696845597503335	ом,0.005070754957886142	эт,0.0028273382911627293	ня,0.0014041357313048044
а,0.01648123040968486	ве,0.004993806685511049	л,0.0028242739794309777	ае,0.0013625972833855061
и,0.015940209149490063	ог,0.004865105592777486	ед,0.0027517519351128584	мн,0.0013499995573771943
го,0.014714484456789459	з,0.004826290977508633	ам,0.0026349676102249953	х,0.0013476162038080542
с,0.014621193188511692	де,0.004705761382726406	ие,0.002559381254175125	ый,0.0013244636262792651
п,0.014620852709430386	ат,0.004499771538536444	зн,0.0025546145470368444	гл,0.0013203778773035963
в,0.014169717926700302	ес,0.004485811896202909	вс,0.002523630950638024	ым,0.0013176540446531505
ст,0.01198997084818106	да,0.00444597584369014	ар,0.002504904601166209	ьн,0.0013159516492466218
о,0.011983842224717555	ил,0.004426909015137019	ю,0.002475282921092611	ич,0.0013132278165961762
на,0.010953552524686435	од,0.004372432362128103	ма,0.002410932374725829	гд,0.0012836061365225783
ь,0.010892606769132712	р,0.004367665654989823	из,0.0023547533263103848	дэ,0.001276456075815158
не,0.010728155372862046	чт,0.004191297490873458	я,0.0023132148783910865	ул,0.001264198828888152
я,0.010525910798566447	н,0.004177678327621229	бо,0.002295850445244495	ят,0.0012577297263433433
но,0.009930412885362736	е,0.004177337848539924	ди,0.002290062300862297	тс,0.0012533034982863689
ни,0.009617512609642775	ит,0.004141587545002823	ну,0.002275762179447457	а,0.0012413867304406684
по,0.008566453685652007	ан,0.004057829691001614	ей,0.002270736708207384	аю,0.0012352581069771653
и,0.008018963322912404	у,0.003982243334951744	ое,0.002200856781560198	уж,0.0012304913998388853
он,0.007966189065310016	мо,0.00395466452936598	ру,0.0021834923484136057	мы,0.0012236818182127709
к,0.007953591339301704	об,0.003950919259471618	му,0.0020660270653631314	лу,0.0012032530733344273
ал,0.007863704861836993	че,0.003924361891129771	ив,0.0020261910128503615	ум,0.0011926982218139499
ен,0.007680527116094515	ри,0.003922999974804548	ад,0.001930516391003453	з,0.0011903148682448099
ко,0.00764818160337047	ем,0.003914147518690599	ки,0.001918259144076447	аг,0.0011882719937569757
го,0.007625369504922987	ти,0.003906656978901873	бе,0.0019114495624503326	вн,0.0011777171422364982
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д,0.007511989970848181	ле,0.003819494334087608	хо,0.001862761053823614	ут,0.0011637574999029635
ра,0.0074905397887259206	ак,0.003788510737688787	сп,0.0018525466813844424	кт,0.0011613741463338235
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ла,0.006551498482484735	ся,0.0034568841124970125	ия,0.001739848105472248	бр,0.0010711471897878067
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ре,0.006317248874546396	аз,0.0033108185866168567	их,0.0017071621136668985	па,0.0010626352127551635
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га,0.006030225009005671	ис,0.003196077136216828	ая,0.0016234042596656904	см,0.0010245015556489224
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щи,0.0008099997344263166	ц,0.0005035685612511653	фо,0.0002866833864594193	вк,0.00016887762432763893
эн,0.0008065949436132594	уш,0.0005011852076820252	зл,0.0002829381165650564	зя,0.00016887762432763893
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сс,0.0007592683513117638	ьш,0.0004599872388440327	ыр,0.00025535931097929275	вь,0.00015423702383149282
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су,0.0007500754161165092	сч,0.0004531776572179182	вд,0.0002533164364914584	чк,0.0001525346284249642
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бл,0.0007415634390838662	лл,0.00044875142916094376	шк,0.00025025212475970687	шо,0.0001481084003679898
лы,0.0007412229600025605	шл,0.0004463680755918037	нд,0.00024854972935317826	зк,0.00014776792128668408
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оя,0.000730668108482083	лж,0.00043138699601435185	яз,0.0002332281706944207	пя,0.00014436313047362683
сн,0.0007245394850185799	ца,0.0004269607679573775	рс,0.00023050433804397492	юс,0.00014368217231101538
ву,0.0007201132569616055	яв,0.0004184487909247344	цо,0.00022675906814961195	еу,0.0001412988187418753
вш,0.0007143251125794083	мя,0.0004143630419490657	б ,0.00022505667274308334	ею,0.00014095833966056958
иц,0.0007095584054411282	зг,0.00041402256286775994	фе,0.00022199236101133182	ьм,0.00014061786057926388
рн,0.0007013869074897907	зм,0.0004024462741033654	ьс,0.00022097092376741466	хв,0.00013993690241665243
ьк,0.0006847034325058103	иб,0.0003973390878837795	ге,0.00021994948652349748	фа,0.0001395964233353467
ги,0.0006843629534245046	пы,0.0003946152552333337	вя,0.00021620421662913453	оу,0.00013925594425404097
гр,0.0006778938508796959	ям,0.0003929128598268051	ящ,0.00021484230030391162	ьш,0.0001378940279288181
еж,0.000669041394765747	ща,0.00039257238074549936	ун,0.00021279942581607728	мс,0.0001378940279288181
ап,0.0006683604366031356	зи,0.00038235800830632765	дд,0.0002100755931656315	дп,0.00013755354884751236
ук,0.0006642746876274669	йс,0.00038201752922502194	щу,0.00020803271867779715	юч,0.0001351701952783723
иш,0.0006544007942696009	рь,0.0003813365710624105	йч,0.00020667080235257427	эд,0.00013482971619706657
ьс,0.000653038877944378	рв,0.0003741865103549903	ац,0.00020598984418996282	хэ,0.00013448923711576084
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уп,0.0006452078590743463	зр,0.00037214363586715593	яе,0.0002029255324582113	дц,0.0001324463626279265
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	дс,0.0003670364496475701	шн,0.00019441355542556822	ьк,0.00012699869732703492

ош,0.0006258005514399201	ур,0.00036635549148495865	ау,0.0001930516391003453	хи,0.00012631773916442347
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гс,3.472886629318381е-05	зб,0.00012461534375789486	тэ,1.6342995902674737е-05	тх,6.809581626114473е-06
щъ,3.438838721187809е-05	ът,0.00012427486467658913	тц,1.566203774006329е-05	нх,6.809581626114473е-06
ш,3.404790813057236е-05	хр,0.0001235939065139777	ьч,1.566203774006329е-05	мц,6.809581626114473е-06
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юз,3.404790813057236е-05	жо,0.0001222319901887548	эз,1.566203774006329е-05	уу,6.469102544808749е-06
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## Bigram with spaces, without intersctions

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## Bigram without spaces, with intersctions

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цн,1.702002811546549е-05	пш,5.6733427051551635е-06	пю,8.104775293078805е-07	
хц,1.702002811546549е-05	мш,5.6733427051551635е-06	эе,8.104775293078805е-07	
зъ,1.702002811546549е-05	зю,4.862865175847284е-06	цх,8.104775293078805е-07	
ыф,1.702002811546549е-05	эс,4.862865175847284е-06	цф,8.104775293078805е-07	
лш,1.6209550586157612е-05	вю,4.862865175847284е-06	щг,8.104775293078805е-07	
фы,1.6209550586157612е-05	пв,4.862865175847284е-06	чз,8.104775293078805е-07	
бд,1.539907305684973е-05	эя,4.862865175847284е-06	фд,8.104775293078805е-07	
гэ,1.458859552754185е-05	чэ,4.862865175847284е-06	цш,8.104775293078805е-07	
шц,1.458859552754185е-05	бт,4.862865175847284е-06	ью,8.104775293078805е-07	
цс,1.3778117998233969е-05	эш,4.862865175847284е-06	жх,8.104775293078805е-07	
жп,1.3778117998233969е-05	жр,4.052387646539403е-06	хъ,8.104775293078805е-07	
чд,1.3778117998233969е-05	цр,4.052387646539403е-06	цч,8.104775293078805е-07	
чп,1.3778117998233969е-05	лш,4.052387646539403е-06	шю,8.104775293078805е-07	
эп,1.2967640468926088е-05	кю,4.052387646539403е-06	шс,8.104775293078805е-07	
зш,1.2967640468926088е-05	шб,4.052387646539403е-06	шг,8.104775293078805е-07	
юш,1.2157162939618208е-05	чб,4.052387646539403е-06	жш,8.104775293078805е-07	
шм,1.2157162939618208е-05	зф,4.052387646539403е-06	сш,8.104775293078805е-07	
бж,1.2157162939618208е-05	пб,4.052387646539403е-06	шп,8.104775293078805е-07	
жг,1.1346685410310327е-05	чя,4.052387646539403е-06	лй,8.104775293078805е-07	
фф,1.1346685410310327е-05	въ,3.241910117231522е-06	жц,8.104775293078805е-07	
жс,1.1346685410310327е-05	шр,3.241910117231522е-06	пз,8.104775293078805е-07	
лц,1.1346685410310327е-05	гх,3.241910117231522е-06	зй,8.104775293078805е-07	
жм,1.0536207881002448е-05	жя,3.241910117231522е-06	чц,8.104775293078805е-07	
чв,1.0536207881002448е-05	эю,3.241910117231522е-06	пм,8.104775293078805е-07	
фю,1.0536207881002448е-05	цз,3.241910117231522е-06		
съ,9.725730351694567е-06	пд,3.241910117231522е-06		
хъ,9.725730351694567е-06	кй,3.241910117231522е-06		
цм,8.915252822386687е-06	шз,2.431432587923642е-06		
фн,8.915252822386687е-06	цэ,2.431432587923642е-06		
жэ,8.915252822386687е-06	кш,2.431432587923642е-06		
чс,8.915252822386687е-06	бш,2.431432587923642е-06		
ьш,8.915252822386687е-06	фв,2.431432587923642е-06		
чч,8.915252822386687е-06	жю,2.431432587923642е-06		
бб,8.104775293078806е-06	гц,2.431432587923642е-06		
эх,8.104775293078806е-06	фъ,2.431432587923642е-06		
цб,8.104775293078806е-06	жз,2.431432587923642е-06		
эф,8.104775293078806е-06	бч,2.431432587923642е-06		
ьшц,8.104775293078806е-06	хю,2.431432587923642е-06		
шд,8.104775293078806е-06	ця,2.431432587923642е-06		
жт,8.104775293078806е-06	бг,2.431432587923642е-06		
тъ,8.104775293078806е-06	щк,1.620955058615761е-06		
шс,8.104775293078806е-06	гж,1.620955058615761е-06		
пэ,8.104775293078806е-06	бую,1.620955058615761е-06		

×

[illegible]

$$0,650697219 < R < 0,520318057$$

## Лабораторная работа №1

[illegible]

$$0,722649876 < R < 0,594776129$$



[illegible]

$$0,774542155 < R < 0,645405863$$

## Висновок:

В цій лабораторній роботі я визначив поняття ентропії на символ джерела та його надлишковості, дослідив та проаналізував різні моделі джерела відкритого тексту для наближеного визначення ентропії, отримав практичні навички оцінки ентропії на символ джерела.